Report of the

SEVENTEENTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE

University of Arkansas
Fayetteville, Arkansas

June 8 - 10, 1960

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SEVENTEENTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE[1]

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PROGRAM

Wednesday - June 8 - Morning

Page No.

Wednesday - June 8 - Afternoon

N. L. Taylor, Presiding

Wednesday - June 8 - Evening

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[1] Reported by: W. A. Kendall, Kentucky; J. E. Halpin, South Carolina; and complied by D. E. McCloud, Permanent Secretary, USDA, Beltsville, Maryland.

Page No.

Thursday - June 9 - Morning

PATHOLOGY, PHYSIOLOGY, AND PLANT BREEDING JOINT SESSION

Wiley Johnson, Presiding

Pathology

Physiology

Breeding

PLANT AND ANIMAL RELATIONSHIPS SESSION

P. G. Woolfolk, Presiding

Wednesday - June 8 - Afternoon

N. L. Taylor, Presiding

Opening Session

Dr. N. L. Taylor, Conference Chairman, officially opened the Seventeenth Southern Pasture and Forage Crop Improvement Conference. Chairman Taylor introduced Dr. M. S. Offutt, who, in turn, introduced Dr. E. M. Cralley, Director of the Arkansas Agricultural Experiment Station. Dr. Cralley officially welcomed the Conference members to Arkansas. He stressed the very rapid development of research work on pasture and forage in the South particularly during the past 17 years the Conference has been active. He stressed that pasture research must be a cooperative venture between animal husbandmen, agronomists, and all allied departments, such as, entomology, agricultural engineering, agricultural economics, plant pathology, and others. He emphasized that forage research must be a balanced program and must be supported by basic research in fields such as plant physiology, animal nutrition, and others. Director Cralley called attention to the development of a finishing program for feeder cattle raised in the South. With the development of increased feed production this is a trend which will increase. He recognized that in the past the South had been slow in developing pasture research and indicated that there have been more advances in pasture research during the past 5 years than in the previous 50. The future is bright for this region which is favored with land potential, climatic potential, and now research personnel to conduct the necessary high-caliber research which will aid in the development of a pasture and livestock industry for the South.

Introduction of Members

Chairman Taylor called on each of the States for introduction of the members present. States and members attending are: Alabama 4, Arkansas 20, Florida 8, Georgia 7, Kentucky 3, Louisiana 4, Mississippi 4, North Carolina 7, Oklahoma 5, Puerto Rico 2, South Carolina 7, Tennessee 4, Texas 8, Virginia 3, and Wisconsin 1; USDA personnel from outside the region, 6, in addition to J. D. Baldridge and Carl Hayward from Missouri, and 1 foreign visitor from Kenya, Africa.

Keynote Address

Director E. M. Cralley introduced the keynote speaker for the afternoon session, Dr. J. G. Dickson from the University of Wisconsin as a scientist both with a long list of research accomplishments and a special ability to provide strong leadership in the training of a host of graduate students.

Diseases in Forage Crop Improvement - J. G. Dickson, Wisconsin Agricultural Experiment Station

Progress in forage crop improvement in the United States during the past two decades has not kept pace with demands for highly productive grasses and legumes for soil cover and feed. On the basis of acreage occupied by forage and turf plants, this is one of the largest agricultural crops of the nation.

With the exception of the bent grasses, clonally propagated, many new selections and polycrosses developed to meet these demands for better grasses have frequently succumbed to disease. The legumes, alfalfa and red clover have fared somewhat better. Possibly a critical analysis of the problems and the methods employed in their solution will assist in defining some of the major blocks to progress.

Perhaps an analytical discussion of the problem based upon a background of 40 years experience in the study of the reaction of genotype to environment by your speaker will stimulate thought and provoke discussion. Whether dealing with the profitable production of the cereals, barley, and wheat from the arctic circle to the equator; speciation in grasses and legumes; or the role of seven single, dominant alleles in corn to the biophysical-chemical reaction to rust, the research is based upon the analysis, selection, and finally synthesis of suitable genotypes through the study of phenotypic reaction to environment. The coincidence that disease is an important part of the environment does not alter the principle, but only the methods and broadens the investigations used.

The role of diseases in the study of the interaction of genotypes to environment and in the selection and use of disease resistant material in crop plant improvement is complex. Generally disease is the result of the interaction of the two genotypes, pathogen and host, to the internal and external environment. Frequently the major effect of the external environment on disease is expressed primarily in one of the interacting genotypes. As for example the allel conditioning rust reaction in inbred corn line B38 is not functionally differential in reaction to _Puccinia sorghi_ above 24° C night temperature, whereas the allel in GG208R functions differentially at all temperatures tested. The same lines of the pathogen are involved in the two comparisons. Or again, corn seedlings are generally susceptible to _Gibberella_ at low temperatures and wheat seedlings principally at high temperatures. The differential reaction of certain wheat varieties to stem rust and stripe rust illustrate the influence of environment principally on the pathogens. Information of this nature is essential for sound progress in breeding for disease resistance. The cooperative investigations of the plant pathologist and the breeder are essential in the accumulation and use of such information.

Several other factors, some again involved with insufficient cooperation, are associated with the slow progress in forage crop improvement. Some will be listed only; others will be discussed briefly. These factors are not necessarily listed in order of importance for this varies greatly with crop-plant use and location.

1. Funds are not sufficient for the support of the basic and applied research on the large number of crop plants involved. Appropriations have increased recently, but not in proportion to the problems or the importance of the crop. However, this is not the major obstacle for research grants are available to teams of investigators who can define and outline important basic investigations on these crop plants. Presently research grant support on forage plants is tragically small compared with that on other crop plants. Perhaps this indicative and associated with the slow progress in organization of intensive research in forage crop improvement.

2. The transition from extensive to intensive research in forage crop investigations is slow for many reasons. Probably the major reason is associated with the study of too many species in too many environments. In North America, species in over 14 genera of grasses and 6 of legumes are receiving some attention by roughly one-third the personnel investigating a few species in 6 genera of the cereal crops. Perhaps too few are attempting too much to expect more than a survey type of research. This deserves serious study in relation to permanent progress in forage research. Certainly intensive, cooperative research concentrated on a few economically important, widely adapted species will result in more progress in understanding the genotypes through phenotypic performance; their limitations and their economic value. Genotype investigations of this nature would in turn furnish the base material, reproducable in nature, for the constructive study of physiological and pathological reactions associated with crop management. At present most of the latter investigations in progress are of limited application because of unknown genotype. This means little discreet knowledge is available concerning the factors of importance and their reaction to environment in determining yield, quality and duration of the variety or the clonal line.

3. The forage-plant breeder is inclined to improvise and stop short of gene analysis and stabilization in breeding material. Self sterility is one of the major blocks to progress. Instead of devising methods to remove the obstruction to progress, plant lines are selected without or after one or at most two generations of selfing and these or polycrosses between them are distributed. This material gives temporary improvement, but being highly heterogeneous soon loses original identity through natural elimination. Diseases and other unfavorable factors of the environment generally play havoc with these unstabilized genetic populations. Recent studies in cytogenetics of the grasses indicate great variability in chromosome behavior and suggest a mechanism for explaining variability and its persistence in breeding material. The chromosome behavior in the grasses studied appears similar to that found recently in the fungi. Other methods of breeding are suggested. Convergent improvement is extremely useful in developing better lines and hybrids. Only a few examples, mostly successful, are reported in grass and legume improvement. Multilineal hybrids and varieties recently demonstrated as a highly efficient method of adding genes or gene groups to well adapted, good quality cereal varieties including corn is used occasionally in forage-crop breeding. Modification of these latter two methods in alfalfa and red clover improvement is producing better varieties of greater stability. Recent statistical analyses of large populations in the successive generations in multilineal hybrids of wheat and corn indicate that genotype can be defined parallel with variety improvement. To insure progress the breeder must not only use modern methods, but also cooperate with the plant physiologist and plant pathologist in more critical evaluation of the plant material employed.

4. The physiological investigations dealing with specific processes of crop management and composition require genotypes of known qualitative and quantitative characters that are reproducable. Closer cooperation and teamwork between the breeders and this group of investigators will improve both the research and the plant material.

5. Plant diseases soon eliminate many of the breeders productions. Potential variability in the pathogens is amply demonstrated and some understanding of the mechanisms conditioning variability is evolving. The breeder can anticipate the play of pathogen-variability even in the most scientifically selected and constructed crop-plant genotypes. However, the future of crop improvement and the use of disease resistant varieties appears more hopeful today than in the past. Primarily because 1) variability is generally recognized as a biological phenomenon; 2) the genetic mechanisms conditioning variability are better known; and 3) the means of coping with them scientifically are evolving.

6. Successful progress in most modern research rests upon closer cooperation, and teamwork between investigators in the several disciplines involved. The plant breeder must call upon the knowledge of the plant pathologist not as a technical tester of his populations, but as a coinvestigator in the analysis of factors involved and their use in crop improvement.

Many forage breeders at present are depending largely upon natural selection to evaluate their material. While natural selection plays an important role in evolution, it is neither rapid enough nor sufficiently reliable for much progress in a life-span. The plant breeder who depends upon natural epidemics of disease to eliminate the susceptible population and too frequently is not aware of the specific pathogen involved from year to year can expect slow progress and many failures.

The plant pathologist investigating forage crop diseases alone correspondingly is inclined to temporize and stop short of real solution of the problem. Frequently he is too easily discouraged by the genetic instability of his material or unaware of the importance of genotype in interpreting disease reactions.

Several illustrations of the problems being solved by cooperation are enumerated. Stem rust of timothy and Kentucky bluegrass attack susceptible plants during the growing season and the rusted plants rarely survive the winter following. This is stem rust damage rather than winter killing. Simple, dominant factors conditioning this rust reaction are known and some have been isolated in clonal lines of these species. The plant pathologist must cooperate with the breeder in the use of these lines through several methods of breeding in the study of their inheritance as well as developing rust resistant varieties. Systematic combinations of these lines with those of outstanding agronomic characteristics to evaluate the use of dominant-resistance in polycrosses and the best methods of production of seed to perpetuate and use the resistance offers a challenge to both investigators. The systematic use of the genes in producing multilineal hybrids is of interest to each investigator. Through crossing these lines individually with an adapted agronomically-superior line followed by the use of the superior line as the recurrent parent in back crossing and subjecting the segregating populations to epidemics incited by the specific physiologic races of the pathogen again presents an investigation in which both can cooperate with some assurance of results.

Again, the use of the Brome rust in the cooperative investigation of broader biological problems involving taxonomy, genetics and plant pathology is presented. _Bromus inermis_ apparently is immune and _B. pumpelleianus_ is susceptible to this rust. The 2 species cross naturally in Alaska where the former,

widely introduced with hay, is associated with the latter indigenous species. Segregation of morphological characters in hybrid populations in continuous between those of these 2 species and apparently includes other presently designated species. The dominant, simple inheritance of rust reaction is extremely useful 1) in determining the genetic status of the plants in relation to speciation and 2) in the use of superior hybrid selections that are rust resistant. Here both basic and applied research profit from the cooperation.

And finally, the results obtained through cooperation in red clover improvement are cited. Here again both basic and applied research progress together. Powdery mildew, northern anthracnose, root rots, and some other diseases are studied intensively and the results applied in the selection, testing and perpetuation of disease resistant varieties. Plant breeders, agronomists, physiologists and plant pathologists cooperate in these investigations. Alfalfa improvement now is progressing through similar cooperative investigations.

Perhaps it is impractical to isolate, analyze and stabilize genotypes through inbreeding in many of the forage plants. Too few have been investigated to state that it is impossible in very many plants.

The immediate need is better teamwork between investigators in the several disciplines involved in forage crop improvement. By means of this cooperation precision can be added to observational investigations as well as to the data collection and interpretation. Cooperation of this type applied to a few of the more important forage plants will elucidate basic information and the methods of using this information in forage crop improvement.

Business Session - Chairman Taylor, presiding

Chairman Taylor appointed a nominating committee composed of Homer J. Wells, P. G. Woolfolk, and Wayne Huffine (Chairman) to present a nomination at the final business meeting for the new executive committee member.

Chairman Taylor appointed a resolutions committee composed of Bob Lankford and Jim Halpin to prepare resolutions to be presented at the final business session.

Chairman Taylor also called for suggestions to the executive committee as an aid in steering the Southern Pasture & Forage Crop Improvement Conference. He indicated that special consideration should be given to future meetings and called the executive committee meeting for 7 p.m., Thursday, June 9. Executive committee is composed of P. B. Gibson, E. C. Holt, N. L. Taylor, M. E. McCullough, M. S. Offutt, and D.E. McCloud with special advisors for dairy P. E. Lush and W. B. Anthony for animal husbandry.

The meeting was then turned over to Dr. M. S. Offutt for announcements concerning the afternoon field tour. A windshield bus tour of the Arkansas Experiment Station facilities was announced for 3:30 p.m. Announcements were made concerning the Thursday afternoon field trip.

Windshield Tour

Windshield tour of research facilities included the dairy, hog, and poultry units; the crops farm, including pathology greenhouses; and the agronomy field plots showing work experiments underway on creeping alfalfa, irradiated lespedeza, vertical mulching, soil fertility, turfgrass breeding, and horticultural research. Detailed field trips to these facilities were conducted Thursday afternoon.

Wednesday - June 8 - Evening

Chicken barbecue sponsored by the Arkansas Seed Dealers Association. Members of the Conference and guests assembled at Agri Park for an excellent chicken barbecue. Guests present included several wives of the Arkansas staff members as well as wives of several visiting members. Dr. Offutt introduced vice-President for Agriculture, J. W. White who welcomed the group to the barbecue. R. L. Thurman introduced Mr. Ralph Clement, Head of the Seed Laboratory of the State Plant Board. Mr. Clement explained the relationship of the State Plant Board and the Arkansas Seed Trade Association.

The group expressed their thanks for the excellent barbecue provided by the Arkansas Seed Dealers Association and to the Agronomy Club who provided for the use of the picnic facilities.

Thursday - June 9 - Morning

PATHOLOGY, PHYSIOLOGY, AND PLANT BREEDING JOINT SESSION

Wiley Johnson, Presiding

Pathology

Alfalfa Rust Studies - R. T. Sherwood, Raleigh, North Carolina

A detached leaflet technique is used in studies of alfalfa rust, caused by *Uromyces striatus*, at Raleigh, N. C. Uredospore inoculum is brushed onto the lower surface of healthy, expanded, excised leaflets. The leaflets are floated on 3 percent sucrose in sterile tap water in petri dishes, and the dishes are kept in cabinets at 21° C. under continuous fluorescent light, 80 f.c. Rust readings are made 14 days after inoculation. There are two types of reaction, e.g. 1) susceptible, with 30 or more medium to large pustules per leaflet and 2) resistant, with no visible symptoms, or necrotic flecks, or flecks and a few minute pustules. Single uredospore lines from a rust collection from one field were found to belong to two physiologic races on the basis of the reaction of individual plant differentials. Only 4 of 165 plants from 10 commercial varieties were resistant to one or both races. Thirteen creeping rooted clones were resistant to race 1 but not race 2. Among selections from the 7th cycle of a phenotypic recurrent selection program, resistance to one or both races occurred in 9 of 21 Block A plants and 19 of 22 Block B plants tested. Some plants are immune from both races. Others are resistant only to race 1 or race 2.

The technique is currently being used to: 1) survey the occurrence of physiologic races in the southeastern U. S., 2) compare cycles of the phenotypic recurrent selection material to gain information on the nature of the genetic advances which have been made, and 3) to study the inheritance of resistance to rust in alfalfa.

The Role of Plant Pathological Research in the White Clover Improvement Program at Clemson - James E. Halpin, South Carolina

At Clemson, a research team consisting of a plant physiologist, a breeder-geneticist, and a plant pathologist under joint state-federal sponsorship is working on white clover improvement. The ultimate goal of the overall program is towards the development of new varieties of white clover superior to those currently available. The immediate goal is to gain information on applied as well as pure aspects of research concerned with the culture of white clover.

Diseases are a major problem in white clover production in the southeast. Nematodes can and do cause severe damage to the plants. Virus diseases such as Bean Yellow Mosaic Virus (BYMV) and Alfalfa Mosaic Virus (AMV) reduce yields as well as quality and may be a factor in shortening the longevity of stands. Soil-borne fungi associated with root and stolon rots also affect the plants adversely. As a result of these and other environmental factors, white clover is not producing up to its potential in many areas of the region.

The program of white clover disease investigations at Clemson is based on: 1) the need for information as to the relative importance and distribution of the various disease producing agents involved, 2) the need to develop techniques for screening and evaluating breeding material for each of the major disease problems, and 3) the need to obtain basic information as to the nature of the disease-causing organism and the relationship between the parasite or infectious agent and the host.

Field surveys have shown the Meloidogyne incognita (including M. incognita acrita) to be the nematode most commonly associated with root-knot of white clover. Field bins have demonstrated the importance of this organism in reducing productivity and shortening stand longevity. Greenhouse studies have led to the development of specially constructed greenhouse benches for the screening of plants to select those which show resistance or at least tolerance to attack by this organism. Variation in resistance or tolerance has been shown to exist and those seed lots where this has been found are being studied more thoroughly. Selected material is being crossed in an effort to increase this resistance.

Studies are currently in progress to evaluate the role of BYMV and AMV in the production of white clover. Likewise, techniques which could be used in a screening program are under investigation. Methods of inoculation to increase efficiency are being considered.

Surveys have been made to obtain information on and cultures of the various species of soil fungi associated with root and stolon rots. Studies on the pathogenicity of organisms thus obtained are currently in progress.

Cooperative Investigations on Blue Lupine Diseases - Homer D. Wells and Ian Forbes, Jr., Georgia

Cooperative investigations of plant breeders and plant pathologists have resulted in determining the mode of inheritance of resistance to anthracnose caused by Glomerella cingulata (Ston.) Spauld. & Schrenk. and gray leaf spot caused by Stemphylium solani Weber, in blue lupine (Lupinus angustifolius L.) and in combining resistance to these two diseases in one agronomically desirable blue lupine strain. Although these diseases frequently cause heavy losses in lupine fields, natural field infection does not result in sufficiently reliable epidemics for critical evaluation of plant disease reactions. Greenhouse screening techniques developed, whereby reliable genetic data could be obtained by the breeder, follow:

Cultures for four isolates each of G. cingulata and S. solani isolated from blue lupines were transferred to petri dishes containing V-8 juice agar. The G. cingulata cultures were grown under routine laboratory conditions for 14 days and the S. solani cultures were grown in a culture room under supplemental light (cultures 14 inches below 40-watt daylight fluorescent bulbs from 8:00 a.m. to 6:00 p.m. each day) for 14 days. The 14-day-old cultures were added to 5 volumes of water and ground 30 seconds in a blender, and the mycelial and conidial suspensions were used as sprays for inoculating 14-day-old greenhouse-grown blue lupine plants. Inoculated plants were placed in a moist chamber and subjected to intermittent fog from a humidifier for a period of 48 hours and returned to the greenhouse benches. Greenhouse temperatures were maintained at 75° to 80° F throughout the incubation period. Disease reaction ratings were made 3 days after inoculations with S. solani and 14 days after inoculations with G. cingulata. When populations were being tested for resistance to both diseases, procedures were as described previously except that plants were first incoculated with S. solani; the gray leaf spot susceptible plants were then discarded, and only the gray leaf spot resistant plants were inoculated with G. cingulata.

Pathological Aspects of Breeding Lupines for Disease Resistance - Stanley A. Ostazeski, Florida

In attempts to find resistance to Phomopsis stem blight (Phomopsis leptostromiformis), 75 lines of Lupinus luteus were screened in greenhouse tests. Three-month-old potted plants were inoculated by piercing the lower stem and inserting a fungus infested toothpick into the wound. Usually at least six plants of a line were inoculated, and their average reaction formed the basis for subsequent classification. After 1 month the lines were evaluated as resistant, intermediate, or susceptible. Of the lines tested, 34 were classed susceptible, 30 intermediate, and 11 resistant. Reactions differed widely within certain lines, some containing both susceptible and highly resistant members. Inoculated plants of lines G-553 and G-554 were uniformly highly resistant, and individual plants of lines G-551 and G-555 were in that category.

In 1957, approximately 150 plants in a 15-acre field of bitter blue lupine survived severe defoliation attributed largely to winter injury. Most of the survivors were injured to varying degrees by cold, Botrytis stem canker (*Botrytis cinerea*), brown spot (*Pleiochaeta setosa*), and gray leaf spot (*Stemphylium solani*) diseases. Seed from 40 of these plants were included in a brown spot inoculation test and found to be highly susceptible. The same size sampling was included in a gray leaf spot inoculation test and found to be highly resistant. Crosses have been made in order to determine the genetic constitution of these new sources of Stemphylium resistance.

Physiology

Selecting Adapted Forage Plants - S. H. West, Florida

Plant growth is regulated by the two broad forces of environment and heredity. The influence of environment can be divided into natural and imposed sources. The natural sources include the limitations or stresses resulting from unfavorable conditions of temperature, moisture, light and carbon dioxide. Imposed sources of stress result from management practices such as clipping, grazing and fertilization. Both sources are for the most part either necessary or uncontrollable.

The ability to withstand the environmental condition of both sources of stress is genetically controlled. The problem of selecting adapted forage plants gravitates to one of selecting out of a highly heterogeneous plant population individuals which will produce maximum growth in a wide range of environmental conditions including extremes.

Alfalfa plants which grew for 6 weeks in a greenhouse in which the temperature reached 120° F for 4 to 5 hours each day were selected for tolerance to high temperature by difference in vigor. Further, vigor and respiration rates at high temperature appeared to be correlated negatively. The respiration rate of the more vigorous plants tended to increase less with an increase of temperature. The lower respiration rates would conserve energy for growth, thereby enabling the plant to survive a greater range of temperatures.

How Can Plant Physiology Contribute to a Plant Breeding Program? - George Beinhart, South Carolina

Current physiological research at Clemson emphasizes analysis of growth of white clover to answer these questions: 1) what changes in growth rates occur in response to seasonal changes in environment?; 2) can growth changes be predicted from readily-measured morphological responses?; and 3) are the morphological responses to environment of genetically different plants correlated with the agronomic performance of these plants?

Growth chamber experiments involving different levels of temperature and light intensity have suggested that these two environmental factors affect growth by influencing the amount of leaf area maintained by plants. This hypothesis is currently being tested by measuring the development of 20 different clones in field plots and 6 of the same clones in growth chambers.

The data from these experiments will be used: 1) to give a detailed picture of seasonal changes in growth pattern, thus increasing our understanding of the nature of plant response to climatic change; 2) to correlate developmental responses with yield and persistence data for the same genotypes in adjacent field plots; 3) to estimate the degree of morphological variability within the species; 4) to evaluate the general significance of the leaf area - growth relationship mentioned above; and 5) through chemical analysis of material from these studies, to find correlations between growth and biochemical responses to environmental changes.

The identification of basic plant responses to specific environmental stresses may lead to techniques permitting the plant breeder to screen large populations and rapidly select those individuals possessing superior ability to endure these stresses.

Contributions of Physiology to Plant Breeding, Red Clover - W. A. Kendall, Kentucky

The Kentucky Agricultural Experiment Station and the U. S. Department of Agriculture have established a cooperative program at Kentucky to study the physiological basis for adaptation of red clover.

In field experiments the greatest losses of plants have occurred soon after harvesting during hot and/or dry weather. The carbohydrate level in roots and stubble of these plants decreased after harvesting and during hot and/or dry weather and appear to be at levels too low to sustain the plants.

In laboratory experiments six types of red clover with various degrees of adaptability to Kentucky conditions were subjected to stresses of temperature, moisture, light, and harvesting treatments. The plants did not differ in size but seemed to differ somewhat in presistence.

It was tentatively concluded that plants with relatively slow rates of metabolism during environmental and management stresses are most adapted to Kentucky conditions. Current research is centered on phases of metabolism such as rates of respiration and depletion of carbohydrate reserves. The information obtained should provide the plant breeder with more refined objectives for his plant-screening and variety-development programs.

The Contribution of Physiological Studies to the Plant Breeding Program - W. E. Knight, Mississippi

Investigations have been conducted at State College, Mississippi on the physiological responses of a number of forage species to light, temperature and management practices. Interesting interactions have been observed between the factors studied.

The results of these investigations can be utilized by the plant breeder in his efforts to improve a particular species. Guide lines have also been provided as the basis for management recommendations. This type of research inevitably results in the pin pointing of problems that need emphasis in an improvement program. These problems are usually those which lend themselves to the team approach in their solution.

Some high lights of our research program are as follows:
Crimson clover: Studies of light and temperature on crimson clover have established that excellent flowering can be obtained by growing the plants under low night temperature for 6 to 8 weeks and then moving the plants to a high night temperature. Flowering can be accelerated by supplemental light but it is not necessary to obtain good flowering. This is useful information to the plant breeder in his efforts to obtain life cycles as rapidly as possible in the improvement program.

Vegetative propagation of crimson clover is possible as in other crops. This technique can provide plant materials with the same genetic make-up for experiments providing different treatments.

Management research in crimson clover shows that seed size and subsequent seedling vigor are related to intensity of defoliation. Maintaining large seed size without undue restrictions on the use of the crop is an ideal problem for the combined approach of the physiologist-plant breeder team. The hard seed problem also enters the picture at this point since hard seedness is related to seed size. This problem is an entire area of research in its own right.

The plant breeder is faced with very little hope for resistance to crown rot, *Sclerotinia trifoliorum* at the present time. Clipping studies on crimson clover indicate that the extensive damage from this disease can be virtually eliminated by utilization of excess forage produced during the times when the organism is active.

Johnsongrass: Johnsongrass is very sensitive to greenhouse temperature. The length of the light period is not as critical with this specie for production of flowering as in other species studied. However, best seed set was obtained under short daylength (normal and 12 hours). A 16-hour daylength delayed seed head formation in Johnsongrass.

Dallisgrass: Dallisgrass was even more sensitive to low night temperature than was Johnsongrass. Low temperature inhibited seed set. Dallisgrass flowered well under 14- and 16-hour daylengths. Plants grown under a 14-hour daylength produced more panicles and a higher percentage of florets containing caryopses than the plants grown under a 16-hour daylength. Shattering of Dallisgrass seed was observed before the glumes turned brown. The plant breeder must take this into account in breeding for seed production. This characteristic of Dallisgrass again suggests a problem for the team approach to the problem of increased seed production and harvesting methods on this crop.

Summary: These investigations have in no instance provided the complete answer to any of the problems studied. In many cases, this research has pin pointed areas of research that needed concentrated attention. It is our belief that progress on these problems can best be made through the combined efforts of a research team.

Examples of Progress Resulting from Cooperative Programs - A. A. Hanson, Beltsville, Maryland

The speaker has the dubious distinction of being not only a substitute but a third string substitute for Doctors Hollowell and Fergus.

If I have any business pinch-hitting for these gentlemen, it might be on the basis of one thing--and that is my firm belief that you can't divorce forage crop breeding (and this includes breeding for disease resistance) from the physiological development of the species in question. In its simplest terms, this means that one must consider how and in what manner the species will be utilized.

This could be illustrated by referring to a slide that Dr. Dickson showed us yesterday. The slide was one showing a mildew-susceptible Kentucky bluegrass plant. It is always nice to know if an undisturbed plant is susceptible to a particular disease, but we must remember that Kentucky bluegrass is ordinarily clipped or grazed. In my limited experience with this species, I have found few plants that won't show some evidence of *Helminthosporium* leafspot or stem rust in unclipped space-planted nurseries. These same clones, however, when rated in well-managed, solid-seeded plots, will range from those eliminated by one or the other of these diseases to those with a very high tolerance to both *Helminthosporium* leafspot and to rust.

We have heard from the speakers this morning of instances where the plant pathologist and the plant physiologist are assisting in the improvement of individual species, or at least, accumulating information that will provide the answers needed to do a more intelligent and efficient job of developing superior varieties. What then about the plant breeder in the South who doesn't have the cooperation of a plant pathologist or a plant physiologist, or a cytogeneticist, etc.? What can he do to obtain assistance? Sometimes he becomes thoroughly disillusioned and goes into administration. If this opportunity does not present itself he might attempt to become a plant pathologist, or a physiologist, or a cytogeneticist, or he might, in fact, become some sort of "synthetic", encompassing all of these disciplines. The end result being that the breeder himself becomes the first and sometimes the last true synthetic variety developed in the course of his research work.

What about all of the species that forage crop breeders are sometimes called on to consider? As I see the problem, it can be very, very bad but not all bad. In the first place, information should be obtained on the characteristics and adaptation of our many grasses and legumes. This information is a help in meeting critical problems that might arise through the loss of species as a consequence of disease or some other cause, and suggest sources of plant material to meet our needs for conservation practices. In addition, information obtained on the characteristics and adaptation of these species can aid in picking those species that have potential for improvement by existing techniques. In a like manner, surveys can provide us with information on species that have many outstanding characteristics but have one or more serious shortcoming on which research effort can be concentrated. It is when the agronomist or breeder comes to understand a species and its drawbacks that he is in the best position to enlist the aid of specialists representing other disciplines. There is no reason to assume

that every research team should consist of a plant breeder, a physiologist and a pathologist. Effective teamwork can be developed between plant breeders and cytogeneticists, plant breeders and biochemists as well as between plant breeders, physiologists and pathologists.

Sometimes the team approach is much easier to talk about than to realize. In the first place, we must remember that research is done by individuals and that teamwork and cooperation is only as effective as the individuals contributing to the total effort. The organization and success of cooperative research depends on the 4 A's--namely, administration, assignment, association and attitude. Administration covers all aspects of support. Lacking support to organize comprehensive improvement programs, the State experiment stations and the Agricultural Research Service have had to compromise in assigning one man to do the job of many. These compromises haven't been all bad, for we need only to consider the example of a plant pathologist who, by careful screening and cataloguing of alfalfa clones, developed Lahontan and Moapa alfalfa. However, we should never consider that because our compromises have given rise on occasion to good varieties, that this type of organizational pattern is one to be emulated. Many examples could be cited where lack of adequate support and research in related disciplines has spelled failure to the breeding effort. Assignment is important from the standpoint of developing cooperation. In a program where a plant pathologist is assigned to support the research effort of one or more breeders, he may well develop an interest in only one of the species, or perhaps only one of the diseases with which the breeder or breeders are concerned. Assignment must be on the basis of research problems. The problem may be broad,e.g., winterhardiness in the improvement of red clover, but the combined effort of the cooperating scientists must be concentrated on well defined objectives within this area of research. Association It is foolhardy to expect men who are many miles distant to cooperate effectively in solving specific research problems. Members of teams should preferably be housed together so that they can discuss mutual problems and develop well integrated research programs. Attitude We must recognize that some people are lone wolves who under no circumstances can or want to contribute to a team effort.

We come, then, to examples of cooperation in the development of forage crop varieties. In my estimation there are few really good examples of forage varieties developed through cooperative research work. Admittedly, the workers at Wisconsin combined genetics and plant pathology in the development of Vernal alfalfa, and similarly, plant breeders and plant pathologists at the University of Kentucky contributed to the development of Kenland red clover. Considerable progress has been made in recent years, and we can cite many examples of where scientists with different sorts of training are cooperating in the development of superior grass and legume varieties. We have heard at these meetings of the excellent progress made at Tifton, Georgia, in studying the pathology and genetics of lupines. In addition, a plant breeder, a physiologist and a pathologist are working on the improvement of white clover at Clemson, South Carolina, while at Lincoln, Nebraska, work in genetics, biochemistry and entomology are contributing to the improvement of sweet clover. Other locations include: College Station, Texas, breeding and cytogenetics in dallisgrass improvement; Lexington, Kentucky,breeding, pathology and physiology in red clover improvement; Madison, Wisconsin,

cytogenetics, pathology and breeding in smooth brome improvement; Tifton, Georgia, cytogenetics, breeding, and pathology in the improvement of bahiagrass and bermudagrass; Gainesville, Florida, breeding, pathology and physiology in the improvement of lupines. Many other examples could be cited but these will suffice to indicate the important gains that have been made within the last few years. There is no question but that plant breeders can increase the scope of their programs and the effectiveness of their work through cooperation with scientists trained in other disciplines. The trend has developed and will continue to the betterment of our forage resources in the southeastern States.

Discussion

Dickson: Why was sucrose used in the substrate for the excised leaves instead of distilled water? The former would enhance contamination.

Cope: The leaflets turned yellow on distilled water and could not be maintained for the desired length of time.

Freeman: What was the effect of light on this procedure?

Cope: No detailed study has been made concerning effects of light.

Dale: Could high pressure spraying be used to inoculate the plants with the virus?

Halpin: Based on experience with this method elsewhere I would say it is too tedious and too many escapes may occur.

Bashaw: What do the physiologists recommend we do to solve the seed shattering problems.

Knight: The physiologists do not have any recommendation. A joint effort between Agricultural Engineers and Agronomists is needed to develop a device, probably a suction apparatus of some type, to solve this problem.

Wells: At Georgia, Dr. Burton has designed a pan which is placed beneath the flowers to catch the seed.

Knight: The Australians handshake the plants for harvesting.

Cope: How much emphasis is placed on basic research in USDA.

Hanson: The administrators are greatly concerned with furthering basic research. This is evident in such ways as the establishment of the Pioneering Research Laboratories. A recent survey within the Department has shown a definite increase in the amount of basic research. I personally feel that the Pioneering Research Laboratories create some difficulties in that no limits are placed on the researchers endeavors. Their research may get out of phase so to speak, i.e., they may lose contact between basic and applied research.

Dickson: There is a tendency to grant funds at the present in such a way as to centralize research. Hugh research centers are constructed, for example, the Atomic Energy Commission recently sought advice from biologists concerning the establishment of a billion dollar research center for work concerning biology. Such a center was not considered advisable for the following reasons: 1) present research problems could be solved most effectively by distributing these funds to

institutions where personnel and equipment are already present, 2) it would eliminate the difficulty of recruiting new personnel and at the same time help to develop and train new personnel for future needs.

The National Science Foundation and the National Institute of Health and Welfare are currently seeking applied rather than pure scientists in the belief that better team work or cooperation between workers will result.

Baldridge: What is the relationship between size of the plant and development of leaves.

Beinhart: I was most concerned with the type of environment which favored development of leaf area. To answer your question if the plant has a good leaf area then it will get more leaf area.

PLANT AND ANIMAL RELATIONSHIPS SESSION

P. G. Woolfolk, Presiding

Energy Metabolism of Dairy Cows on Pasture - D. R. Waldo, C. E. Coppock, and L. A. Moore, Beltsville, Maryland

Tracheotomized cattle are used to allow collection and sampling of the expired air for 24-hour periods. The calculation of heat production is accomplished using the nonprotein respiratory quotient method. The digestible dry matter or organic matter intake is estimated using either nitrogen or plant pigment regression equations and total collection of feces. In the calculation of the net energy requirement for maintenance while grazing, all heat production values are regressed on all intake values for each individual cow. The extrapolated heat production value at zero feed intake is considered an estimate of net energy for maintenance. On two dry Jersey cows these estimates were 7.5 and 9.1 Therms per 1,000 pounds body weight when based on 11 observations each. Since considerable animal variation exists in the maintenance requirement, these values obtained on pasture should be compared with the values on dry feeds for the same cows and not Armby's standard of 6.0 Therms. This method uses the same assumptions, with slight differences, as calculations based on cows fed in chambers. The technique gives a mean estimate of the net energy requirement for grazing maintenance of individual cows consuming pasture varying in both quality and quantity rather than individual estimates based on variations in quantity only. The estimates of nutrient intake on pasture are subject to much more error than those directly measured in chambers.

Results of Five Years Research at "Beef Research Unit"[1] - G. B. Killinger, Florida

In the early 1940's it was generally agreed by researchers and cattlemen in Florida that more first-hand information or facts were needed on the over-all pasture, beef cattle, cow-calf relationships with respect to economics--or more simply profits from a beef enterprise.

Great strides were made in the 1940's with pasture species coupled with fertilization and management in Florida. It was found economical to establish adapted white clover varieties and five new productive perennial grasses adapted to Florida conditions were released. The new grasses: pangola, pensacola bahia, argentina bahia, coastal bermuda and suwanne bermuda were all superior to the existing pasture species being commonly grown--that is primarily carpetgrass, common bahia and common bermuda. The superiority of the new grasses rested in ease of establishment, more efficient utilization and ability to utilize more fertilizer, higher production of forage and generally better quality forage. The quality of cattle improved greatly during the 1940's with improved breeding, better and more forage and improved herd and pasture management partly the result of a "No Fence Law" passed by the Florida Legislature in 1949. The period following the No Fence Law found Florida beef cattle confined by fences to more restricted areas which made for a forced type of rotational grazing. This also resulted in the planting of more improved pastures and the use of more fertilizer and lime materials. Very few acres of carpet, common bermuda or common bahiagrass pasture have been planted in Florida since 1952 and many of the older pastures of these species have been replaced with the newer grasses and white clover. The location or soil type generally planted to pasture changed from the more rolling, well drained, sandy soils to the nearly flat wet sandy soils during this period. Water control by canals and irrigation of the wet flat soils made them ideally suited for pastures.

Early in 1951 a detailed plan was cooperatively developed at the University of Florida by five major departments in Agriculture for the study of the cow-calf, pasture production problem. Agronomy, Soils, Animal Husbandry, Agricultural Engineering and Agricultural Economics with assistance from Veterinary and Entomology departments made up the working B.R.U. Committee. A flat wet sandy soil area near Gainesville from Leon fine sand the predominating soil type was purchased for the experiment. Florida has between 12 and 15 million acres of similar soil in the state and this in turn is similar to many millions of acres of Gulf coastal plains area of neighboring states. Pine trees, gallberry, hog palmetto and wiregrass predominate as the plant population on this type of soil.

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1 Credit for the material and data in this report is due the cooperating Departments working on this project, namely, the Departments of Agronomy, Animal Husbandry and Nutrition, Soils, Agricultural Economics and Agricultural Engineering. Personnel directly responsible for the planning, operation, collecting of data and reporting results are: G. B. Killinger, M. Koger, W. G. Blue, R. E. L. Greene, H. C. Harris, J. M. Myers, A. C. Warnick and N. Gammon. Heads of the five Departments involved and the Experiment Station Directors are due credit for their counseling, advice and financial support of this project. An Experiment Station Bulletin is in the process of publication and should be released during 1960.

As the details of the project developed it was found feasible to superimpose a cow breeding program on the cow-calf, pasture experiment. One hundred and twenty head of 2-year-old open heifers of brahman-native breeding were purchased in 1952 as the basic cow herd. Two pure bred bulls each of Herford, Angus, Shorthorn and Brahman breeds were purchased to service the cows.

The land area was cleared of all native vegetation including trees in late 1951 and the liming, fertilizing and planting of grasses started in March 1952. All grass planting was completed by July 1952 and all pastures fenced and fresh well water piped to each individual pasture. Grasses established rapidly and in June the pensacola bahia pastures were combined for seed with a 200 pound per acre average. In November the 0-12-12 fertilizer was applied to all clover-grass pastures and a mixture of clover seeds planted. An excellent stand and growth of clover resulted. The cattle were divided according to weight and general appearance into 16 uniform lots and these were placed in the experimental pastures in March 1953.

The eight programs developed in this experiment with acreage per replicate and fertilizer treatments are shown in tables 1 and 2. Each replicate of each program was fenced into three separate pastures with one pasture each of pensacola bahia, pangola grass and coastal bermuda with each pasture planted to a pure grass species. Programs 1, 2 and 3 were all grass with low, medium and high rates of fertilization. Program 4 consisted of 2/3 grass pasture and 1/3 clover grass. Programs 5, 6 and 7 were all clover grass pastures with normal fertilization, high fertilization and high fertilization plus irrigation. Program 8 consisted of one acre of clover grass in combination with 2.5 acres of native pasture.

The breeding season was March through May each year. Grass hay and/or silage were harvested each year, weather permitting and fed back to cattle on the same area. One-third of each program was reserved for winter pasture with cattle removed in August and returned in December or January as feed became scarce. Salt, mineral mix and bone meal were available to all cattle at all times. It was necessary to supplement the cattle on certain programs during the winter with a protein supplement. Intake of mineral and protein per cow per program per year is shown in table 3 for the 1953-57 period.

The pregnancy rate by program in percent is shown in table 4. It should be noted that the pregnancy rate of nursing cows from 1953 through 1955 was very low under the all grass programs 1, 2 and 3. During 1956 and 1957 this siutation improved, probably due to age of cows correlated with type of forage. In all cases the pregnancy rate of cows on clover-grass was higher than those on grass alone. Data shown in table 5 show a significant difference in interval from calving to first estrus during the 1954 and 1955 seasons. The clover-grass fed cows required only 72.5 days whereas the grass fed cows had an average period of 90.3 days.

Production performance of cows for the 5-year period is shown in table 6. The weaning weight of calves from each program was quite uniform. Beef produced per acre in terms of calf weight ranged from 83 to 287 pounds. However, the low yield of beef came from the program using native and improved pasture.

Beef production per cow varied from 263 to 377 pounds. The acre value and per cow value of beef ranged from $13.11 to $44.49 and $39.96 to $59.19.

Tables 7 and 8 list some of the factors considered in the economics of each program. Table 9 is a summary table with pasture establishment and maintenance costs along with value of beef return and required price of beef per pound to break even. Program 5, the clover-grass program with normal fertilization, gave the most return per dollar invested. With beef selling at 12.9 cents per pound this program would break even. The grass pastures with complete fertilizer and nitrogen top dressing were the most expensive to operate. Program 8 with some native pasture in combination was next in economy. Forage yields, protein content and total protein in pounds per acre per year are shown in table 10. Pastures under program 6 heavily fertilized and irrigated yielded the most forage, were highest in protein content, and produced the most protein per acre. Program 5 pastures with only half the fertilizer as program 6 and no irrigation almost yielded as much forage and protein. Programs 1, 2 and 3 with three rates of fertilization yielded forage in the order and magnitude of fertilization.

Phosphorous content of the native soil and at the end of the 5-year experiment as well as extractable phosphorous is shown in tables 11 and 12.

Table 1. Beef Research Unit forage plants and fertilization, 8 pasture programs

Program number	Plant type	Fertilization N	P_2O_5	K_2O
1	Grass	34	18	18
2	Grass	68	36	36
3	Grass	120	72	72
4	2/3 Grass	68	36	36
	1/3 Clover-grass	0	72	72
5	Clover-grass	0	72	72
*6	Clover-grass	0	144	144
7	Clover-grass	0	144	144
8	1A Clover-grass	0	72	72
	2.5A Native	0	0	0

2 Replications - 3 pastures per program per replication

Table 2. B.R.U. Acreage and fertilization

Program	Acres	Rate	Formula	Nitrogen
1	16	225	8-8-8	16#
2	12	450	8-8-8	32#
3	8	900	8-8-8	48#
4	3 1/3	600	0-12-12	---
	6 2/3	450	8-8-8	32#
5	8	600	0-12-12	---
*6	6	1200	0-12-12	---
7	8	1200	0-12-12	---
8	6	600	0-12-12	---
	16	--	---	---

* Irrigated program

Table 3. Mineral and protein intake 1953-57

Program Number	Mineral intake per cow pounds	Cottonseed pellets per cow pounds	Acres per cow
1	51	55	2.67
2	45	73	2.00
3	35	83	1.33
4	31	41	1.67
5	25	--	1.33
6	16	--	1.20
7	27	--	1.23
8	22	55	4.00

Minerals: 1/2 trace mineralized salt
1/2 steamed bone meal

Table 4. Pregnancy rate by program, 1953-57

Years	1	2	3	4	5	6	7	8
				Nursing cows				
1953	0	0	0	0	75	62	50	62
1954	0	0	0	14	60	38	80	38
1955	0	33	43	87	100	86	89	100
1956	88	100	80	100	83	100	75	90
1957	91	91	100	100	90	100	100	67
				Dry cows				
1953	--	--	100	--	--	--	--	--
1954	100	100	100	100	100	100	100	100
1955	100	100	100	100	100	100	100	100
1956	100	80	50	--	--	--	--	--
1957	--	--	--	--	--	100	100	100
Avg.*	63.1	63.8	66.1	75.8	85	82.7	81.8	74.5

* Mean weaning percent for all cows.

Table 5. Interval from calving to first estrus, 1954-55

Program number	Number cows	Average interval
1	7	98.4
2	10	94.2
3	9	75.4
4	12	75.4
5	16	75.9
6	16	69.4
7	15	66.5
8	9	76.8
Grass	26	90.3
Clover	61	72.5

1.5 - Services per conception not significant

Table 6. Production performance of cows, 1953-57

Program Number	Weaning weight	Beef production per acre	Beef production per cow	Value of beef per acre	Value of beef per cow
1	417	99	263	$15.15	$40.24
2	423	135	270	20.66	41.31
3	408	202	270	29.90	39.96
4	435	198	330	30.49	50.82
5	443	282	377	44.27	59.19
6	417	287	345	44.49	53.48
7	421	280	344	42.84	52.63
8	428	83	331	13.11	52.30

Table 7. Annual charges for cattle

Labor
Breeding fees
Veterinary expenses
Medications
Taxes
Cow depreciation
Interest on livestock inventory
Other

Table 8. Agronomic charges

Fertilizer and minor elements
Limestone
Spreading of fertilizer and lime
Miscellaneous maintenance
Harvesting silage
Interest on investment
Feed and minerals
Pasture establishment
Labor

Table 9. Summary cost establish, maintain and returns, 1953-57

Program number	Cost establish	Annual cost	Value beef	Cents/pound break even
1	91.09	27.51	15.15	27.9
2	98.99	39.40	20.66	29.2
3	101.30	62.63	29.90	31.0
4	105.38	37.00	30.49	18.7
5	114.43	36.31	44.27	12.9
6	113.18	51.97	44.49	18.1
7	114.38	51.66	42.84	18.5
8	31.09	12.61	13.11	15.2

Table 10. Forage yields, 1953-57

Program number	Oven-dry forage lb/A	% Crude protein	Total per/A protein
1	4663	6.4	299
2	6462	7.0	450
3	8602	8.0	642
4	8248	9.0	737
5	8756	12.4	1124
6	9214	13.0	1193
7	9063	11.5	1052
8	7566	11.5	866
Native -	2168	4.8	104

Table 11. Applied and in soil in pounds/A-Total P_2O_5

Program number	Determined 1951	Applied 1952-57	Determined 1957
1	125	111	294
2	152	222	444
3	140	544	439
4	146	222	352
	153	544	451
5	149	544	444
6	118	804	450
7	140	804	477
8	150	544	503

Table 12. Ammonium acetate (pH 4.8) extractable P_2O_5

Program and	lbs. P_2O_5 annual	Pounds per acre P_2O_5 51	53	54	55	56	57
1	18	14	11	8	15	10	25
2	36	14	17	15	20	13	45
3	72	14	29	29	34	32	53
4	36	14	13	13	28	16	45
	72	14	16	19	43	34	36
5	72	14	16	12	18	15	27
6	144	14	28	29	52	64	100
7	144	14	31	22	46	41	76
8	72	14	23	17	14	19	30
	---	14	8	5	--	4	8

Thursday - June 9 - Afternoon

Field Trips

A choice of six separate field trips was offered depending on the interest of the individual. Field trips were: 1) dairy pastures and forage, 2) beef and sheep pastures in forage, 3) forage crops pathology, 4) grass breeding, 5) legume breeding, and 6) forage sorghum breeding. Discussion leaders for the field trips were Doctors Rakes, Stallcup, Nolan, Davis, Dale, Offutt, and Thurman.

Friday - June 10 - Morning

S. H. West, Presiding

Physiology of Disease Resistance

Biochemical Nature of Plant Diseases in Relation to Selection - T. E. Freeman, Florida

In recent years, plant pathologists have emphasized the biochemical approach to the elucidation of the host-parasite relationship. Two general lines of endeavor have grown out of this approach. One deals with the physiological effects that the invading parasite induces in the host, i.e., what happens to a plant when it becomes diseased. The second line, and the one dealt with in this presentation, is the study of biochemical factors within a host that governs the success or failure of an organism to cause a disease in

that host, i.e., what biochemical factors are responsible for a plant being resistant to a disease.

Two hypotheses have been set forth regarding the nature of these biochemical factors. The first of these is the balanced nutrition hypothesis proposed by Lewis (3). This hypothesis states that the outcome of a host-parasite relationship is determined by the interaction between the parasite and the water-soluble, diffusible substances provided by the potential host to the potential parasite. These substances must be in the host in the proper combinations and quantitites needed by the parasite. The second hypothesis, proposed by Garber (1) in 1956, expands on the previous one by the addition of another variable in addition to the nutrients. This latter one is known as the nutrition-inhibition hypothesis of pathogenicity. Garber considers two environments in the host that directly affect the fate of an invading parasite; a nutritional environment and an inhibitory environment. Thus, for a parasite to be successful in a host it must encounter an adequate nutritional environment and a noneffective inhibitory environment. Any of the other three possible nutrition-inhibition combinations would result in avirulence of the parasite.

The approach to use in determination of the exact nature of the factors postulated in the preceding hypotheses is obvious--compare the biochemical constituents of resistant and susceptible varieties. This comparison would include materials that may be important in the nutrition of the parasite such as vitamins, amino acids, sugars and nitrogen base compounds as well as materials such as phenolic compounds, organic acids and antimetabolites, which may act as inhibitors of the parasite. By such a comparison it is possible to define the factors responsible for resistance of certain plants to specific diseases (2, 4). The knowledge of such factors could be put to practical use in several ways. For example, it could be used to formulate new approaches to disease control through the use of chemicals such as enzymes, antimetabolites, inhibitors, etc. which would change the disease reaction of the host. Still another, that could be used immediately, would be in the selection process for disease resistance in a breeding program. It would make it possible to select on the basis of simple chemical tests carried out in the laboratory. Such a method has many advantages over conventional selection in the field. The most obvious is the time that could be saved. In addition such a procedure would be more critical and thus subject to less error.

Such a program of research on the biochemical nature of disease resistance in plants has been initiated at the University of Florida. In this program, chromatographic and electrophoretic techniques are being utilized to assay for differences that occur between resistant and susceptible varieties that could account for their respective disease reactions. At the present, two nonrelated diseases are being studied, victoria blight of oats caused by *Helminthosporium victoriae* and gray leafspot of St. Augustine grass caused by *Piricularia grisea*. Considerable progress has been made in the case of both diseases, however, with the latter, certain differences have been established which apparently are associated with the disease reaction of the host. The factors by which resistant and susceptible St. Augustine selections differ occur in the nitrogen pool.

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Effects of Plant Stress on the Incidence of Root Rot in Red Clover - W. A. Kendall, Kentucky

Wherever red clover is grown depletion of stands is usually associated with one or a combination of stresses upon the plants such as relatively extreme temperature, moisture, light, harvesting of tops or seed production. In many instances evidence of root rot has been noticed on the plants. Such observations have led to the generalization that plant stress enhances the development of root rot.

Several experiments are described in which sterile seedlings cultures of Kenland red clover about 1 week old were inoculated with Sclerotium bataticola (Taub.) and subjected to various stresses. Removal of the cotyledons enhanced the development of disease symptoms on plants growing on a water substrate. Incubating the seedlings on a sucrose substrate resulted in the most rapid development of symptoms and the severity of the disease was not influenced by the removal of the cotyledons. It was inferred that disease development was related to the amount of carbohydrate in the root available for growth of the fungus and not proportional to the total carbohydrate in the root. Differences between these two values might be influenced by rates of metabolism and permeability of the host cells which in turn would be influenced by plant stress. The permeability of cell walls of seedlings and mature plants subjected to various stress were measured by the deplasmolysis method and no differences were observed which might account for differences in susceptibility.

Plant and Animal Relationships

The Effect of Growth Regulators on Yield, Annual Production, and Quality of Forage Grasses - O. Charles Ruelke, Florida

It has been stated by H. B. Sprague that the whole field of growth regulators probably has far greater significance than is currently apparent. The truth of this statement is borne out in research conducted at the Florida Agricultural Experiment Station.

Several problems confront the Florida farmers and ranchers. One of the problems is providing forage in early spring and late fall when perennial grasses tend to be dormant despite favorable temperature and moisture conditions. A second problem concerns the winter survival of frost sensitive

forage plants. A third problem concerns animal performance as effected by chemical composition of forage and pasture grasses.

Experiments conducted at the Gainesville, Florida Station have shown that significant increases of early spring grazing and late fall grazing could be achieved by the application of 50 grams of gibberillic acid in the early spring and fall. Over-all annual yields were unchanged.

Experiments carried on to determine the minimum economical rates of applications have shown that reducing the rates from 50 grams per acre to 5 grams per acre will produce measurable increases in early spring and late fall grazing, however, these differences are of small magnitude. Until the cost of gibberillic acid is materially reduced it would not be economically feasible to use it at this time.

Use of a growth inhibiting substance (Maleic Hydrazide) has shown a strikingly beneficial effect on winter survival of frost sensitive Pangolagrass. Applications of this material to fall fertilized grass plots resulted in limited winter injury when untreated plots were completely killed by the frost.

The chemical composition of forage has been significantly altered by the application of growth stimulators and growth depressers. Application of 50 grams per acre of gibberillic acid generally decreased the protein percentage of the forage while there was an increase in total protein produced, because of the increased yield of dry matter. Application of gibberillic acid did not change the percentage of total available carbohydrates in the forage.

Application of a growth depressing substance (Maleic Hydrazide) substantially reduced the protein percentage of the forage produced, but greatly increased the percentage of the carbohydrates in the forage produced.

These experiments show that growth regulators will significantly alter yields, distribution of production, winter survival and chemical composition of forage grasses.

<u>Component Parts of the Sorgo Plants for Silage</u> - R. L. Thurman, O. T. Stallcup, C. E. Reams, Paul Catlett, E. J. Wehunt, and R. P. Nester, Arkansas

Sorgo plants were divided into heads, leaf blades, leaf sheaths and stalks. The yield of leaves and heads did not differ per acre for the varieties and hybrid at a location during a single year. They did differ among years and locations. The difference between the green weight yield of two varieties or hybrids appeared to be stalk weight. For example, the difference between a 15 and 20 ton green weight yield per acre was 5 tons of stalks per acre.

Management practices such as rates of planting and nitrogen sidedressing failed to increase the weight of the leaves and heads per acre. Their weight did not vary significantly for different stages of maturity from the boot to the mature grain stage, on a dry weight basis.

The crude protein content was the highest for green leaf blades, followed by that of the average for the leaf blades and next the heads. It was much lower for the leaf sheaths and stalks.

The coefficient of digestibility of the dry matter varied from 51.85 to 64.21 percent. It was higher for the leaf blades than the other parts of the plant. It was indicated that the head (less the grain) was of the same dry matter composition as the stalk. The coefficient of digestibility for the ensilage from the stalks was 53.44.

The coefficient of digestibility of the protein was the highest for the ensilage from RS 301 with the heads removed. It was higher for the ensilage from Atlas with the heads removed than from Atlas (whole plant) 44.21 and 36.53, respectively. The fact that some of the leaf area of the Atlas was deteriorated should account for the coefficient of digestibility of the protein being below that of RS 301.

The coefficient of digestibility of the protein in the stalks (most of the leaf sheath was included) was 00.07. There was a strong indication that the protein of the heads (less the grain) was similar to that of the stalks. Thus the digestible protein of the sorgo plant was contributed by the leaf blades and grain. However, the amount consumed per day was controlled by the amount of stalks present which limited the intake.

The Acceptability of Grass-Legume Silage by Dairy Cattle - L. A. Moore and and J. W. Thomas, Beltsville, Maryland

Growing dairy heifers consume less grass-legume silage dry matter and have a slower rate of growth than when fed good quality hay harvested from the same field. The decrease in acceptability of silage dry matter is not due to the water per se in the silage. The effect is, however, related to the water content of the crop at the time it is ensiled. Palatability of the silage does not appear to be the factor concerned. It is tentatively postulated that some constituent(s) is formed during the fermentation process, possibly in the nitrogen fraction, which affects the appetite of the animal.

Discussion

Holt: Did you find that your high rate of nitrogen affected this disease reaction?

Freeman: Yes. Silicon may also be a factor.

Offutt: Do you care to comment on the nitrogen level in the field that would be desirable?

Freeman: No. However, we are trying to check this in current field studies.

Dickson: If I may inject a comment here, Mr. Chairman, I would like to mention the effect in rice. As you go above the balanced level of fertility, natural resistance appears to be lost.

Freeman: In our St. Augustine work, the addition of increased nitrogen, it has not lost, its resistance, our resistant selection.

Henson: Have you found any phenolic compounds in your grasses that might be important?
Freeman: Yes, we have found them. However, the test is not critical enough as yet to evaluate them.

Holt: Have you studied some of the diploid forms?
Freeman: Yes. Although we have not obtained any flowers.

Holt: What affect does Maleic Hydrazide have on spring recovery?
Ruelke: With high nitrogen fertilizer applications, it preserves the stand. Without high nitrogen fertilizer applications, it did not.

Offutt: Does it look like you get equal spring growth?
Ruelke: Yes.

Ward: How soon after applying your Maleic Hydrazide did you get your increase in carbohydrate?
Ruelke: Four weeks were involved here.

McClain: Was there any difference in persistence with the use of Gibberillic acid without the use of fertilizer?
Ruelke: No.

Browning: Did you notice differences in quality of silage due to differences in fermentation?
Thurman: There were slight pH changes. Smell, etc. were similar, but stalks alone proved to be a poorer material.

Bennett: Have you tried any spacing tests?
Thurman: Yes, but it did not appear to affect the leaf area.

Spooner: What was the pH of the silage?
Waldo: We don't know. However, it was of good quality and would probably be in the lower range.

Business Meeting - Chairman N. L. Taylor, Presiding

Chairman Taylor expressed thanks from the SPFCIC to the program committee composed of P. B. Gibson, J. E. Halpin, S. H. West, and P. Woolfolk and to E. A. Hollowell, ex-officio member of the program committee. Chairman Taylor also extended thanks to program chairmen of the various sessions, the recorders, and the participants as well as the members present all who contributed to the success of this year's meeting.

The nominating committee composed of H. D. Wells, P. G. Woolfolk, and Wayne Huffine (Chairman) nominated R. M. Patterson as a new member of the executive committee. Patterson's election was by unanimous acclaim. Following the usual pattern of accession, the newly elected member is elevated to Conference Chairman in 1963. Resolutions committee composed of Bob Lankford and Jim Halpin. Committee chairman Lankford modestly designated Halpin to present the report of the committee to the Conference. The following resolutions were presented:

Be it resolved that the Seventeenth Southern Pasture and Forage Crop Improvement Conference go on record expressing thanks to the administration and staff of the University of Arkansas for the excellent facilities, and fine hospitality, and to express appreciation to the program chairmen, participants including guest speaker, Dr. Dickson, and to all who contributed to the success of the meeting. Special appreciation is expressed to the Arkansas Seed Dealers Association for the excellent chicken barbecue and to the Agronomy Club for the use of Agri Park. Appreciation is expressed to Director Cralley, Dr. Offutt, and all of the local staff who worked generously for the success of this year's meeting.

Report on the executive committee meeting covered the following items: decision to forward a request to appropriate personnel at Beltsville that next year's meeting be held there on or about June 12, 1961; tentatively accepted an invitation to meet at College Station, Texas, in 1962; considered improvement of future Conference meetings and appointed a committee of 15 to study the frequency and type of meetings and make a survey of the conferees relative to suggestions for improvement. Committee is as follows: Anthony (Chairman), Brenes, Offutt, Killinger, Craigmiles, Owen, Woolfolk, Bennett, Cope, Huffine, Gibson, Fribourg, Holt, Shoulders, and McCloud.

Call for business and announcements from the floor yielded no new business.

Chairman Taylor expressed his thanks to the members present for their attendance at the meetings, to the executive committee, the Arkansas Agricultural Experiment Station for the excellent facilities and the fine tours, and especially to Dr. M. S. Offutt for his efforts in local arrangements.

The 1961 Conference chairman, M. E. McCullough, introduced in absentia. His executive staff includes: E. C. Holt (1961), N. L. Taylor (1962), M. S. Offutt (1964), R. M. Patterson (1965), and D. E. McCloud, Secretary.

12:00 noon Conference adjourned

REGISTRATION LIST - 1960

Name	Address	Affiliation
Alabama		
Anthony, W. B.	Auburn	Alabama Agr. Expt. Station
Donnelly, E. D.	"	" " "
Johnson, W. C.	"	" " "
Patterson, R. M.	"	" " "
Arkansas		
Byrd, Morris	Little Rock	Soil Conservation Service
Clary, D. N.	Fayetteville	Arkansas Agr. Expt. Station
Clement, R. H.	"	" " "
Cralley, E. M.	"	" " "
Dale, J. L.	"	" " "
Davis, A. M.	"	" " "
Fulton, J. P.	"	" " "
Herman, J. C.	"	" " "
Jacks, J. F.	Keiser	" " "
Johnson, D. L.	Fayetteville	" " "
Noland, P. R.	"	" " "
Offutt, M. S.	"	" " "
Spooner, A. E.	"	" " "
Stallcup, O. T.	"	" " "
Templeton, G. E.	"	" " "
Thurman, R. L.	"	" " "
Walters, H. J.	"	" " "
Wellhausen, H. W.	Little Rock	" " "
Womack, D. E.	Fayetteville	" " "
Jones, J. P.	"	" " "
Florida		
Freeman, T. E.	Gainesville	Florida Agr. Expt. Station
Hodges, E. M.	Ona	" " "
Killinger, G. B.	Gainesville	" " "
Linden, D. B.	"	" " "
Ostazeski, S. A.	"	" " "
Prine, G. M.	"	" " "
Ruelke, O. C.	"	" " "
West, S. H.	"	" " "

Name	Address	Affiliation
Georgia		
Craigmiles, J. P.	Experiment	Georgia Agr. Expt. Station
Elrod, J. M.	"	" " "
Forbes, I.	Tifton	Ga. Coastal Plain Expt. Sta.
Langford, W. R.	Experiment	Reg. Pri. Plant Intro. Sta.
Morcock, J. C.	Atlanta	Allied Chem. & Dye Crop.
Sell, O. E.	Experiment	Georgia Agr. Expt. Station
Wells, H. D.	Tifton	Ga. Coastal Plain Expt. Sta.
Kentucky		
Kendall, W. A.	Lexington	Kentucky Agr. Expt. Station
Taylor, N. L.	"	" " "
Woolfolk, P. G.	"	" " "
Louisiana		
Allen, M.	Franklinton	SE La. Dairy & Live. Expt. Sta.
Brock, W. A.	"	" " "
Ellzey, H. D.	"	" " "
Morgan, N. D.	Shreveport	American Potash Institute
Maryland		
Hanson, A. A.	Beltsville	U. S. Department of Agriculture
Hanson, C. H.	"	" " "
Henson, P. R.	"	" " "
McCloud, D. E.	"	" " "
Waldo, D. R.	"	" " "
Mississippi		
Bennett, H. W.	State College	Mississippi Agr. Expt. Station
Browning, C. B.	"	" " "
Johnson, C. M.	"	" " "
Knight, W. E.	"	" " "
Missouri		
Baldridge, J. D.	Columbia	Missouri Agr. Expt. Sta.
Hayward, C. C.	"	Missouri Col. of Agriculture

Name	Address	Affiliation
North Carolina		
Carlson, I. T.	Raleigh	No. Carolina Agr. Expt. Station
Cipolloni, Mary Ann	"	No. Carolina State College
Cope, W. A.	"	No. Carolina Agr. Expt. Station
Everett, J. P.	"	No. Carolina State College
Gilbert, W. B.	"	No. Carolina Agr. Expt. Station
Mochrie, R. D.	"	" " "
Smart, W. W. G.	"	" " "
Oklahoma		
Chessmore, R. A.	Ardmore	Samuel Roberts Noble Foundation
Elder, W. C.	Stillwater	Oklahoma Agr. Expt. Station
Huffine, Wayne	"	" " "
Lynd, J. Q.	"	" " "
Nelson, A. B.	"	" " "
Puerto Rico		
Rivera-Brenes, Luis	Rio Piedras	Puerto Agr. Expt. Station
Fortuno, J. V.	"	" " "
South Carolina		
Beinhart, E. G.	Clemson	South Carolina Agr. Expt. Station
Conley, Cecil	"	" " "
Gibson, P. B.	"	" " "
Halpin, J. E.	"	" " "
Maurer, T. C.	Spartanburg	Soil Conservation Service
McCarter, S. M.	Clemson	Clemson Agricultural College
McClain, E. F.	"	South Carolina Agr. Expt. Station
Tennessee		
Burns, J. D.	Knoxville	Tennessee Agr. Expt. Station
Chandler, E. K.	"	National Plant Food Institute
Fribourg, H. A.	"	Tennessee Agr. Expt. Station
Turner, J. R.	"	Pacific Coast Borax
Texas		
Bashaw, E. C.	College Station	Texas Agr. Expt. Station
Holt, E. C.	"	" "
Johnson, P. R.	Tyler	" "
Lewis, R. D.	College Station	" "
Norris, M. T.	McGregor	" "
Riewe, M. E.	Angleton	" "
Staten, R. D.	College Station	" "
Weihing, R. M.	Beaumont	" "

Name	Address	Affiliation
Virginia		
Shoulders, J. F.	Blacksburg	Virginia Agr. Expt. Station
Taylor, L. H.	"	" " "
Ward, C. Y.	"	" " "
Wisconsin		
Dickson, J. G.	Madison	Wisconsin Agr. Expt. Station
District of Columbia		
Ely, R. E.	Washington	U. S. Department of Agriculture
Foreign		
Poultney, R. G.	East Africa	Kenya Department of Agriculture

Total Attendance: 96